ORIGINAL

WILKINSON) BARKER) KNAUER) LLP

1800 M STREET, NW
SUITE 800N
WASHINGTON, DC 20036
TEL 202.783.4141
FAX 202.783.5851
WWW.WBKLAW.COM

December 13, 2016

VIA HAND DELIVERY
Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street, SW
Washington, DC 20554

Re: National Railroad Passenger Corporation (d/b/a Amtrak) Request for Waiver of Sections 15.407(a)(1)(iii) and 15.407(a)(3) of the Commission's Rules

Dear Ms. Dortch:

Transmitted herewith on behalf of the National Railroad Passenger Corporation d/b/a/ Amtrak are an original and four copies of its Request for Waiver with respect to the above-referenced Commission rules. Should there be any questions concerning this matter, please contact the undersigned.

Respectfully submitted,

Robert D. Primosch

cc: Julius Knapp
Geraldine Matise
Ira Keltz
Bruce Romano
Michael Ha
Jamison Prime
Karen Rackley
Howard Griboff

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
The National Railroad Passenger Corporation d/b/a Amtrak	)	ET Docket No. _____
	)	
	)	
Request for Waiver of Sections 15.407(a)(1)(iii) and 15.407(a)(3) of the Commission's Rules	)	Accepted / Filed
	)	DEC 13 2016
To The Office of Engineering and Technology		Federal Communications Commission Office of the Secretary

REQUEST FOR WAIVER

NATIONAL RAILROAD PASSENGER CORPORATION
d/b/a AMTRAK

Vincent R. Brotski,
Senior Associate General Counsel
60 Massachusetts Avenue, N.E.
Washington, DC 20002

Lawrence J. Movshin, Esq.
Robert D. Primosch, Esq.
Mark A. Settle, P.E.
Wilkinson Barker Knauer, LLP
1800 M Street, N.W.
Suite 800N
Washington, D.C. 20036
(202) 783-4141

December 13, 2016

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The National Railroad Passenger Corporation ("Amtrak") requests that the Commission, subject to the conditions proposed in Exhibit A hereto, waive Sections 15.407(a)(1)(iii) and 15.407(a)(3) of its rules to permit Amtrak's point-to-point trackside network along the Northeast Corridor ("NEC") to operate under the technical specifications that apply to fixed point-to-point operations in the 5.15-5.25 GHz ("5.1 GHz," or "U-NII-1") and 5.725-5.825 GHz ("5.8 GHz," or "U-NII-3") bands.

Since its inception, Amtrak's on-train Wi-Fi service has used spectrum from commercial wireless service providers to provide connectivity. Due, however, to overwhelming passenger demand for bandwidth (already exceeding one terabyte per day on Acela trains alone), Amtrak is constructing a private trackside network along the NEC that provides dedicated capacity in the UNII-3 band for Amtrak's Wi-Fi and other broadband-related services. Testing of the network commenced last year, confirming that Amtrak's TSN can achieve download speeds of over 44 megabits per second (a six-fold improvement over Amtrak's typical pre-TSN download speed). Amtrak's TSN ultimately could achieve download speeds measureable in hundreds of megabits per second.

This substantial improvement of Amtrak's Wi-Fi service cannot be sustained with a single 80 MHz channel in the UNII-3 band. The UNII-1 band could provide Amtrak with a second 80 MHz channel that takes advantage of the IEEE 802.11ac standard and that also assures consistency of coverage in a cost efficient manner. But, under Section 15.407(a)(1)(iii), client radios for non-fixed operations in the UNII-1 band are limited to an output power of 250 mW with antenna gain up to 6 dBi. Were Amtrak to operate at this power level, it would have to construct three times as many trackside stations to achieve the coverage it already achieves in the 5.8 GHz band. This would dramatically increase Amtrak's capital costs, delay network deployment and otherwise undermine the business case for Amtrak's TSN.

Conversely, the Commission's technical specifications for fixed point-to-point systems potentially would permit Amtrak to operate its TSN with *fewer* trackside stations. Because, however, each trackside mast would need to serve comparable coverage areas in both the U-NII-1 and U-NII-3 bands to achieve Amtrak's capacity objectives, Amtrak needs to operate in both bands under the same technical specifications, *i.e.*, those that apply to fixed point-to-point systems. Thus, Amtrak is seeking a conditional waiver to permit operation of its TSN as a fixed point-to-point network in the U-NII-1 and U-NII-3 bands, similar in concept to the waiver the Office of Engineering and Technology recently granted in *Deere & Company*.

Good cause exists for issuance of the requested waiver under the conditions proposed herein. First, as passengers demand more bandwidth at a time when connections of 50 Mbps or better are common, a grant of the waiver will give Amtrak the capacity it needs both to maintain the existing improvements to its Wi-Fi service and consistently deliver even faster connection

speeds as it builds out its TSN. And, since Amtrak is a federally funded entity, any cost savings derived from the requested waiver will ultimately redound to the benefit of taxpayers.

The requested waiver poses no meaningful risk of aggregate interference to Globalstar's satellites in U-NII-1 band. Even without the requested waiver, Amtrak estimates that it will need to construct less than 800 trackside stations to cover the entire NEC, which is *de minimis* when compared to the number of outdoor Wi-Fi access points that are, or will eventually will be, deployed in the U-NII-1 spectrum. After adding the on-train radios with which those stations communicate, the total number of transmitters in Amtrak's TSN will still be fewer than 1,000, and far less than that number will actually be transmitting at any given time.

Moreover, Amtrak's trackside stations transmit a narrow beamwidth, with all of the energy in each transmission focused on oncoming train-based radios going up and down the track. Through the use of technical approaches including but not limited to antenna beamwidth, azimuth, directionality and polarization, Amtrak's TSN has been designed to minimize any RF signal "bleed" outside of Amtrak's right of way. This, combined with the relatively small number of transmitters in the network and the intermittent nature of their transmissions, will substantially mitigate any potential interference to users of either the U-NII-1 or U-NII-3 bands. In fact, a grant of the requested waiver for both the U-NII-1 and U-NII-3 bands will likely reduce the potential for interference by permitting Amtrak to use fewer trackside stations spaced further apart, thus minimizing an already nominal risk of interference to authorized users of those bands.

Nonetheless, and consistent with OET's approach in *Deere & Company*, Amtrak is proposing to condition the requested waiver in a manner which ensures that other authorized users of the 5.1 GHz and 5.8 GHz bands are sufficiently protected from interference. The proposed conditions will more precisely tailor the waiver to the unique facts presented (and to the Commission's interference protection objectives) while permitting Amtrak to operate with the facilities necessary to deliver the public interest benefits discussed herein.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
The National Railroad Passenger Corporation (d/b/a Amtrak)	)	ET Docket No. _____
	)	
	)	
Request for Waiver of Sections 15.407(a)(1)(iii) and 15.407(a)(3) of the Commission's Rules	)	
	)	
	)	

To: The Office of Engineering and Technology

REQUEST FOR WAIVER

The National Railroad Passenger Corporation ("Amtrak"), by its counsel and pursuant to Section 1.3 of the Commission's rules,[1] respectfully requests that the Commission (acting through the Office of Engineering and Technology under delegated authority) waive Sections 15.407(a)(1)(iii) and 15.407(a)(3) of the Commission's rules to permit Amtrak to operate a trackside network ("TSN") along the Northeast Corridor ("NEC") under the technical rules that apply to fixed point-to-point operations in the U-NII-1 (5.15-5.25 GHz) and U-NII-3 (5.725-5.85 GHz) bands. The requested waiver would serve the public interest by (1) providing Amtrak with needed capacity for its Wi-Fi and other operations on the NEC, without creating any increased risk of interference to authorized users of the U-NII-1 and U-NII-3 bands; (2) enabling Amtrak to deliver the next level of "connected train" service to millions of travelers at lower cost; and (3) advancing the Commission's efforts to accelerate high-speed broadband deployment throughout the country.

---

[1] 47 C.F.R. § 1.3. *See also ICO Global Communications (Holdings) Limited v. FCC*, 428 F.3d 264 (D.C. Cir. 2005); *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969).

I. BACKGROUND

A. AMTRAK'S NORTHEAST CORRIDOR RAIL SERVICE

Amtrak is the nation's only high speed intercity passenger rail provider. It serves more than 500 destinations in 46 states and the District of Columbia, operating more than 300 trains daily over 21,300 miles of track. Amtrak trains operate at a top speed of 150 mph, with more than half operating at speeds of 100 mph or more. In 2015, nearly 31 million passengers rode Amtrak. When compared to U.S. airlines, Amtrak ranks sixth in domestic passengers carried. Amtrak also is a leading provider of passenger rail services, including engineers, train crews, dispatching, and other operational support to transit and commuter rail agencies throughout the United States.[2]

The NEC, one of the busiest and most complex rail routes in the Western Hemisphere, is Amtrak's most heavily traveled route, connecting Washington, D.C. to Boston. Approximately 750,000 Amtrak and commuter passenger trips are taken on the NEC every day, representing nearly half of Amtrak's passenger count.[3] The population along the NEC is expected to grow significantly, and that growth will translate into increased demand for Amtrak's service.[4]

The NEC also provides substantial economic benefits by expanding the number of communities within reasonable commuting distance of regional employment hubs, in a fashion that is often faster and

---

[2] DeGood, "Understanding Amtrak and the Importance of Passenger Rail in the United States," Center for American Progress (June 4, 2015), https://www.americanprogress.org/issues-/economy/reports/2015/06/04/114298/understanding-amtrak-and-the-importance-of-passenger-rail-in-the-united-states.

[3] *See* Aratani, "WiFi on Amtrak's Acela Express trains shifts into faster gear," *Washington Post* (November 3, 2016), https://www.washington-post.com/news/dr-gridlock/wp/2016/11/03/wifi-on-amtraks-acela-express-trains-shifts-into-faster-gear/ ("Six of Amtrak's busiest stations are in the Northeast Corridor, considered the crown jewel of the railroad's operations, with New York and Washington ranked first and second for passenger traffic.").

[4] *Id.* ("Demographers project that between 2010 and 2040, the population in the corridor will grow to 64 million, an increase of roughly 23 percent."). Amtrak estimates that annual trips on the NEC will increase from 260 million in 2009 to 520 million by 2040.

more reliable over longer distances than automobile traffic.[5] The NEC's impact on the American economy is also felt in the national aviation system. More than half of the nation's recorded flight delays originate at one of the New York and Philadelphia area airports. Amtrak's NEC rail service relieves this pressure by transporting more passengers for trips along the NEC than all airlines serving these areas combined.[6]

B. AMTRAKCONNECT

In March 2010, Amtrak launched free Wi-Fi service ("AmtrakConnect") aboard Acela Express Trains that run along the NEC. Amtrak has since rolled out the service to the rest of its NEC fleet, and now over 90% of Amtrak's ridership has access to AmtrakConnect. Every month Amtrak's NEC passengers conduct approximately 6.5 million Wi-Fi sessions and transfer over 100 terabytes of data.

Since its inception, Amtrak's Wi-Fi service has used commercial cellular network service providers for connectivity.[7] Those carriers' networks are also used by the general public for mobile voice and data consumption. The resulting contention for connections, and thus bandwidth, is strong and changes dynamically from minute to minute. Furthermore, cell towers are not located strategically to serve trains running on the NEC. As a result, coverage is not uniform and the achievable throughput

---

[5] According to a 2014 study completed by the Northeast Corridor Infrastructure and Operations Advisory Commission, created by Congress to develop coordinated strategies for improving rail service on the NEC, seven million jobs are located within five miles of an NEC station. "The Northeast Corridor and the American Economy," at iv (April 2014), http://www.nec-commission.com/wp-content/uploads/2014-/02/NEC_american_economy_report.pdf.

[6] *Id.*

[7] Today, each train has a communications control unit (CCU) located within a single car (the "brain car"). The CCU uses multiple concurrent 3G and 4G cellular links supplied by all four major US wireless carriers. In turn, the connection is distributed wirelessly to Wi-Fi access points (APs) located throughout the train so that passengers have connectivity in every car. The aggregated traffic is sent from the train via antennas mounted on the rooftop of the "brain car" over the commercial cellular networks to servers at Amtrak's east coast data center, where packets are reassembled and sent to the Internet.

of Amtrak's Wi-Fi service is neither consistent nor predictable. In 2014 Amtrak typically was able to provide a download speed of 10 Mbps to Amtrak's NEC trains; in 2015, Amtrak's average connection speed on the NEC dropped over 40% to less than 6 Mbps. Over the same period of time, airlines and buses have been aggressively expanding the availability of their passenger Wi-Fi services, [8] putting Amtrak at a disadvantage when competing for business and leisure travelers.

Of course, inconsistent service levels have a direct and material effect on the passenger experience. Amtrak's research reflects, for example, that 74% of all business travelers prefer to use broadband rather than a cellular data service, and that 87% of travelers feel angry, frustrated or anxious when broadband connectivity is not available at the speeds to which they are accustomed. Other data confirms that Internet access is extremely important to Amtrak's ridership: during peak Acela travel times, 85% of all passenger devices – including laptops, tablets and mobile phones – are connected to Amtrak's Wi-Fi service.

The simple fact is that rail passengers, like virtually all airlines, bus, and other mass transit customers, now view on-board Wi-Fi as a necessity, not an amenity. To stay competitive and remain a valuable travel resource, Amtrak must be able to improve its Wi-Fi service.

In addition to the risk of poor performance, continued reliance on commercial cellular networks forces Amtrak to face the real possibility that grandfathered 'unlimited' data plans may cease, exposing Amtrak to unacceptably high monthly charges that could force the closure of the AmtrakConnect service or require Amtrak to impose such significant limitations on use of its WiFi service that it would

---

[8] *See, e.g.,* Riegler, "American Airlines to Offer Faster Wi-Fi via Viasat" (Nov. 9, 2016), http://www.frequentbusinesstraveler.com-/2016/11/american-airlines-to-offer-faster-wi-fi-via-viasat/; Elliott, "These Airlines Have the Best Wi-Fi in the World" (Jan. 14, 2016), http://fortune.com/2016/01/14/airlines-wifi-internet/; Estes, "Every Major Airline's Wifi Service, Explained and Ranked" (May 4, 2015), http://gizmodo.com/every-major-airlines-wifi-service-explained-and-ranked-1701017977; "Greyhound Introduces New Onboard Wi-Fi Platform and Updated Website" (Sept. 22, 2014), https://www.greyhound-.com/en/media/2014/09-22-2014.

no longer provide a meaningful customer experience. Accordingly, Amtrak has determined that the only effective way to guarantee the long-term viability of its Wi-Fi service will be to provide dedicated train-to-ground capacity for Amtrak's exclusive use. Amtrak thus is committed to migrating its Wi-Fi and other broadband related services to a private TSN.

C. AMTRAK'S TSN

Amtrak has commenced testing and deploying components that would make up a TSN designed to deliver high-speed connectivity to trains travelling along the NEC. In 2015, Amtrak completed a "proof of concept" segment of the TSN along a 10-mile portion of the NEC south of Wilmington, DE, using a 40 MHz channel in the U-NII-3 band for communications between the trackside access points and the rail cars. Amtrak's testing established that implementation of a private TSN represents the most technically and commercially viable way for Amtrak to provide reliable, high-capacity broadband connectivity along the NEC.[9] Amtrak has therefore begun to expand the TSN beyond the proof of concept in order to deliver high-speed connectivity to trains travelling along other portions of the NEC.

Specifically, in 2016 Amtrak expanded the original proof of concept network to include 22 new trackside antenna locations between Wilmington, DE and Philadelphia, PA. The expanded TSN is comprised of (1) U-NII-3 access points configured with an 80 MHz channel installed on 60-foot masts constructed, on average, approximately 0.8 miles apart along Amtrak's right of way (ROW) on the NEC,[10] and (2) radios installed on each train in the NEC fleet.[11] The coverage areas of the access points

---

[9] Amtrak found that aggregate throughput speeds of 44 Mbps were achievable (roughly six times faster than the currently typical speed of Amtrak's Wi-Fi service), with peaks over 60 Mbps and average latency of just 16 milliseconds. Amtrak believes that its TSN ultimately may achieve connection speeds measureable in hundreds of megabits per second as construction progresses.

[10] In turn, the access points are connected directly to Amtrak's fiber network, and thereafter to the Internet.

[11] Each Amtrak train is equipped with two radios that communicate with Amtrak's access points. No more than one of those train-based radios is communicating with the TSN at any given time, so the

overlap, so that if one access point fails the adjacent access point is able to provide an adequate signal to an oncoming train.

II. AMTRAK NEEDS ADDITIONAL CAPACITY TO MEET CUSTOMER REQUIREMENTS

Unfortunately, the substantial improvement in Amtrak's Wi-Fi service that can be accomplished with the TSN cannot be sustained with just one 80 MHz channel. Demand already exceeds one terabyte per day on Acela trains alone. With the unprecedented growth in the use of smartphones, tablets and other data-consuming devices and in applications using video and other bandwidth intensive services, Amtrak has estimated that by 2019 its passengers will consume more than five times as much data as they do today.[12] Moreover, consumer expectations are high, as many Americans already have a fixed home broadband connection that delivers 50 Mbps or better.[13]

To deliver the expected level of performance, Amtrak's TSN must offer wideband channels capable of delivering the required capacity. Wider channel bandwidths are essential if consumers and service providers are to realize the benefits of the IEEE 802.11ac standard, which can deliver much faster speeds and more efficient spectral use than its predecessors.[14] Amtrak's experience – and

---

number of trains in operation, not the number of radios, determines how often the spectrum will be used along the entire length of NEC track.

[12] *See also* Malesci, "Connected Railways Can Improve Railway Safety," *Masstransitmag.com* (Sept. 28, 2015), http://www.masstransitmag.com/article/12109763/connected-railways-can-improve-railway-safety ("The goal of most high-speed train operators over the next five years is to allow a seamless connectivity on board. . . Increasingly more passengers bring multiple devices on board with them and want to either work or entertain themselves using their own devices.").

[13] *See Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion (2016 Broadband Progress Report)*, Opinion, 31 FCC Rcd 699, 711 n. 85 (2016).

[14] *See, e.g., Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band,* Notice of Proposed Rulemaking, 28 FCC Rcd 1769, 1794 (2013) ("The introduction of the IEEE 802.11ac standard . . . can open new windows to wireless broadband for many users. The deployment of wide channel bandwidths with higher data rates in the 5

validation by the proof of concept – confirms that 80 MHz is the minimum channel bandwidth necessary to take full advantage of 802.11ac's more robust capabilities.[15] But, the U-NII-3 band only has a single usable 80 MHz channel (channel 155). This will not deliver enough capacity to handle the growing demand for bandwidth on the NEC. Indeed, unless additional bandwidth is identified, Amtrak estimates that its single channel U-NII-3 system could reach full capacity in as little as two years.

Amtrak has considered multiple alternatives, and determined that spectrum in the 5 GHz band will best satisfy its need for additional capacity. First, commercially available equipment that capitalizes on the wider bandwidths in the 802.11ac standard already operates in the 5 GHz band. Second, Amtrak has carefully studied non-5 GHz spectrum and determined that there are no reasonably available options. For example, licensed spectrum below 3 GHz is either unavailable or uneconomical to obtain along the entire length of the NEC. Amtrak's on-train and in-station Wi-Fi services already use the unlicensed 2.4 GHz band to connect to passenger devices, rendering the spectrum unavailable for train-to-trackside connections. In addition, the ubiquity of 2.4 GHz devices would make use of the spectrum highly vulnerable to external interference. The 3.5 GHz band is encumbered by exclusion zones and grandfathered users that preclude use of that spectrum along portions of the NEC. Spectrum bands at or above 6 GHz have propagation characteristics that make them impractical for use in Amtrak's TSN.

Amtrak has also analyzed the possibility of using the UNII-1, UNII-2 and UNII-4 bands. The U-NII-2A (5.25-5.35 GHz) and U-NII-2C (5.470-5.725 GHz) bands are subject to power level restrictions and Dynamic Frequency Selection requirements that would make implementation of the

---

GHz band can help meet the challenge that rapid growth in demand has posed for the wireless industry which has called for more spectrum to increase network capacity.").

[15] *See, e.g.,* Ordman, "802.11: speed versus width on 80 MHz channels," *Criticalcomms* (Oct. 17, 2013), http://www.radiocomms.com.au/content/utilities/article/8-2-11-speed-versus-width-on-8-mhz-channels-891638015 ("To get the true gain out of 802.11ac you need to deploy it in 80 MHz channels.").

TSN considerably more complex.[16] Amtrak has also considered the U-NII-2B (5.35-5.47 GHz) and U-NII-4 (5.850-5.925 GHz) bands. However, given the regulatory uncertainty surrounding their use for federal radar systems and Dedicated Short Range Communications (DSRC), respectively, and the pending rulemaking issues related to resolving interference, Amtrak has determined that those bands are not a reasonable alternative at this time.

In terms of the Commission's technical rules, U-NII-1 is the closest companion band to the U-NII-3 band, and 80 megahertz channelization is available in both. Amtrak therefore considers U-NII-1 to be the best alternative band for expanding capacity on its TSN.

III. AMTRAK NEEDS TO PROVIDE SUFFICIENT COVERAGE

Amtrak's trackside stations and train-based radios must be able to provide the required coverage along the entire NEC in an economic fashion. Under the Commission's Rules, U-NII-1 access points are permitted a conducted power level of 1 Watt with up to 6 dBi antenna gain (36 dBm EIRP), provided that emissions above 30 degrees from the horizon do not exceed 125 mW (21 dBm).[17]

Unfortunately, client radios operating in the U-NII-1 band are restricted to a maximum power of 250 mW with up to 6 dBi antenna gain.[18] This drop in power materially reduces the geographic range within which client radios may communicate with associated access points. If Amtrak uses the U-NII-1 band under current Commission rules, the reduction in coverage area would require deployment of *three times* as many trackside access points in order for Amtrak to operate as efficiently as it currently does in the U-NII-3 band. This would dramatically increase Amtrak's capital costs, delay network deployment

---

[16] *See* 47 C.F.R. § 15.407(a)(2), (h)(2).

[17] *Id.* § 15.407(a)(1)(i)

[18] *Id.* §15.407(a)(1)(iv).

(since three times as many access points would need to be constructed to provide contiguous RF coverage of the NEC) and otherwise undermine the business case for Amtrak's TSN.

Conversely, the technical parameters in the Commission's rules for fixed point-to-point systems potentially would permit Amtrak to operate its TSN with *fewer* trackside stations as compared to using omnidirectional trackside stations, resulting in reduced capital costs and reduced maintenance expenses. However, because each trackside mast would need to serve comparable coverage areas in both the U-NII-1 and U-NII-3 bands to achieve Amtrak's capacity objectives, Amtrak needs to operate in both the U-NII-1 and the U-NII-3 bands under the same technical parameters, *i.e.*, those that apply to fixed point-to-point systems.

Thus, Amtrak is seeking a waiver to permit operation of its TSN as a "fixed" point-to-point network in both bands. Notably, the Office of Engineering and Technology ("OET") previously waived a similar "fixed" requirement in *Deere & Company* where it was demonstrated that the waiver would have negligible interference consequences and would serve larger public interest objectives.[19] Specifically, OET waived Section 15.703(f) to allow a fixed TV White Space device to be installed on off-road, in-motion agricultural equipment.

In *Deere & Company*, the petitioner contended, among other things, that it needed the higher power permitted for fixed TVWS devices due to the significant size of the agricultural fields where the subject devices would be used. In granting the requested waiver, OET noted, *inter alia,* that (1) the device in question – in function and technical parameters of operation – was much more akin to fixed devices than personal/portable devices; (2) the permissible scope of the device's mobility was tightly circumscribed; and (3) the restrictive parameters of operation coupled with the technical rules for fixed

[19] *Deere & Company Request for Limited Waiver of Part 15 Rules for Fixed White Space Devices*, Order, 31 FCC Rcd 2131 ("*Deere & Company*").

devices did not increase the likelihood of interference. OET also found that granting the waiver (along with other waivers issued in the same decision) would support broadband machine-to-machine ("M2M") communications among farm equipment and a broad variety of agricultural applications.

As shown above, much of the reasoning in *Deere & Company* applies with equal force to Amtrak's waiver request. As in *Deere & Company*, the Amtrak system is similar to a fixed operation in function and technical characteristics. As in *Deere & Company*, the locations of Amtrak's devices are not ubiquitous, and have a limited, readily identifiable geographic range of operation. As in *Deere & Company*, a variety of factors substantially mitigate potential interference to other users of the spectrum at issue. And, both cases are driven by public interest considerations favoring promotion of broadband-based technologies that benefit consumers and the economy.

IV. WAIVER REQUEST

A. THE GOOD CAUSE STANDARD

The Commission is authorized to waive its rules where the petitioner demonstrates good cause for such action.[20] Good cause may be found where "particular facts would make strict compliance inconsistent with the public interest."[21] "To satisfy this public interest requirement, the waiver cannot undermine the purposes of the rule, and there must be a stronger public interest benefit in granting the waiver than in applying the rule."[22] The Commission has also found that a waiver request satisfies its

---

[20] *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969).

[21] *Northeast Cellular*, 897 F.2d at 1166; *see also ICO Global Communications*, 428 F.3d at 269 (quoting *Northeast Cellular*); *WAIT Radio*, 418 F.2d at 1157-9; *Deere & Company*, 31 FCC Rcd at 2134.

[22] *Id.*; *see also WAIT Radio*, 418 F.2d at 1157 (stating that even though the overall objectives of a general rule have been adjudged to be in the public interest, it is possible that application of the rule to a specific case may not serve the public interest if an applicant's proposal does not undermine the public interest policy served by the rule); *Kyma Medical Technologies Ltd.*, Order, 31 FCC Rcd 9705, 9707 (OET 2016).

public interest requirement where it would serve some larger public interest objective (*e.g.*, broadband deployment or advancement of new broadband-related technologies or services) that could not be achieved via strict application of the rule in question.[23]

B. GOOD CAUSE EXISTS FOR ISSUANCE OF THE REQUESTED WAIVER

1. The Waiver Will Create Substantial Public Interest Benefits That Outweigh the Benefits of Strict Application of the Rules.

Aggressive deployment of high-speed broadband services to all Americans remains a high priority of the Commission. American consumers, however, no longer demand high-speed broadband connections just in their home or workplace. They now expect that those connections will be available to them during the substantial amounts of time they devote to commuting, and to business and leisure travel.[24]

Amtrak's limited TSN operation in the U-NII-3 band has already proven that substantial benefits will accrue in the form of dramatically improved connection speeds and lower latency for Amtrak's nearly 15 million passengers on the NEC. As passengers demand more and more bandwidth at a time when connections of 50 Mbps or better are common, a grant of the requested waiver will give Amtrak the capacity it needs to both maintain the existing improvements to its Wi-Fi service and consistently deliver even faster connection speeds, potentially up to hundreds of megabits per second. By allowing passengers access to a level of broadband service on the train that is comparable to what they receive at

---

[23] *Id. See also Deere & Company*, 31 FCC Rcd at 2138.

[24] "Customer demand for a safe, entertaining, and enjoyable travel experience is dramatically increasing. Rail travelers today, . . ., expect onboard Wi-Fi, a variety of entertainment options, and access to accurate, up-to-date travel information. These offerings and add-ons are no longer considered luxuries but are necessary for railway companies to stay in business. . . If rail operators want to compete with buses, cars, and planes as preferred transportation options, they need to keep up with the latest technological advancements and meet customers' high expectations for the overall travel experience." Weatherburn, "Three Trends Driving Wireless Tech in the Railway Industry," (Feb. 29, 2016), http://www.connectorsupplier.com/three-trends-driving-wireless-tech-in-the-railway-

home or at work, productivity is improved, passenger experience is enhanced, and rail travel remains a viable alternative to other modes of transportation that offer high-speed Wi-Fi access. The requested waiver will also give Amtrak the spectrum capacity it needs to maintain and build upon a variety of other ongoing programs that will increasingly require a reliable wireless broadband link between on-train equipment and back-office systems.[25]

Lastly, since Amtrak is a federally funded entity, any cost savings derived from the requested waiver will ultimately redound to the benefit of taxpayers. Those cost savings include reduced capital outlays from having to construct fewer trackside stations, and lower maintenance and other costs as a result of increased operating efficiencies.

2. The Particular Facts Here Would Make Strict Compliance Inconsistent With The Public Interest.

It cannot be denied that Amtrak's TSN is a point-to-point network. There simply are no multipoint or omnidirectional transmissions. Each trackside station only transmits to a single train-based radio at any given time, and only when a train is in position to form the other end of the link.[26] Each trackside station's antennas have a narrow beamwidth (18 degrees) and thus do not "bleed" RF signals into neighboring areas outside of Amtrak's right-of-way.

Amtrak does not claim that its TSN operates as a fixed network. However, in allowing fixed point-to-point devices in the U-NII-1 band to operate with higher gain antennas, the Commission noted that "[s]uch point-to-point operations are typically highly directional and aim their signals along the

---

[25] Such programs improve operating efficiency and may include:

- On-board passenger information systems;
- IP-based video surveillance for passenger and rolling stock;
- E-ticketing and concession point-of-sale; and
- Condition-based monitoring of IP-enabled train components.

[26] Likewise, each client radio only communicates with each base station that it "sees." Due to the speed of the train, a client radio may "see" several base stations in less than a minute.

earth, and therefore are less likely to contribute significant energy to the satellite. They are also relatively few in numbers as compared to the widespread distribution of access points examined by Globalstar and NCTA."[27] The characteristics of Amtrak's operations are consistent with those described by the Commission:

> (1) Amtrak's stations transmit in a highly directional manner; and
>
> (2) the number of Amtrak's trackside stations is *de minimis* when compared to the number of outdoor Wi-Fi access points that are or will eventually be deployed nationwide in the U-NII-1 band.[28]

Also, like a fixed point-to-point network, the location of Amtrak's transmitting devices is always known – trains cannot and do not travel outside of Amtrak's right-of-way. So, it is not inappropriate to characterize Amtrak's TSN as having characteristics typical of fixed operations.

In fact, the *only* distinction between the Commission's characterization of a typical "fixed" point-to-point network and the Amtrak TSN is that one end of each of Amtrak's point-to-point links is in motion, whereas both ends of a fixed point-to-point link are not. But that distinction is not dispositive – the potential for Amtrak's TSN to cause interference is no greater than it would be if Amtrak's trains were not moving. In fact, given that Amtrak's trackside stations only transmit intermittently, it is reasonable to believe that they will pose *less* risk of interference than an "always on" fixed point-to-point link.

Amtrak is not seeking an unconditional waiver or a waiver of general applicability, nor is Amtrak asking the Commission to redefine what "fixed" means. Amtrak also is not seeking to operate at power levels higher than those permitted for fixed point-to-point devices. Under the circumstances,

---

[27] *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127, 4140 (2014) ("*5 GHz First Report and Order*").

[28] *See* Section IV.B.3 *infra.*

the unique facts presented here would make strict compliance with the "fixed" requirement inconsistent with the public interest, and grant of the waiver clearly would not undermine the purposes of the rules at issue.

3. The Waiver Would Not Create Any Additional Interference To Authorized Users Of The U-NII-1 or U-NII-3 Bands.

The U-NII-1 band is allocated on a primary basis to the Aeronautical Radio Navigation Service (ARNS) for both Federal and non-Federal operations and on a primary basis for Fixed Satellite Service (FSS) (Earth-to-Space) for non-Federal Mobile Satellite Service ("MSS") feeder link operations.[29] There currently is no use of the ARNS in the U-NII-1 band, and it appears from Commission records that Globalstar is the only MSS operator in the United States licensed to use that spectrum.[30]

When the Commission opened the U-NII-1 band for outdoor use, the Commission examined the possibility of aggregate interference to Globalstar's satellites from outdoor devices deployed nationwide.[31] In Amtrak's case, that risk of aggregate interference is virtually non-existent now and will remain so if Amtrak is permitted to operate its TSN as a fixed point-to-point network.

Amtrak estimates that it will need to construct fewer than 800 trackside stations to serve the entire NEC. In addition, each Amtrak train is equipped with two radios that communicate with Amtrak's trackside stations. Amtrak presently runs a total of 111 trains on the NEC; 20 are Acela trains and 91 are regional trains. Thus, it is expected that Amtrak's TSN will require fewer than 1,000 trackside and train-based radio units in total.

---

[29] 47 C.F.R. § 2.106.

[30] *5 GHz First Report and Order*, 29 FCC Rcd at 4134. Specifically, Globalstar's satellites are connected to the phone network and the Internet through a terrestrial network of gateways that use the 5.096-5.25 GHz band for uplink communications.

[31] *Id.* at 4136.

Even with this limited number of total units , the actual number of radios that will be transmitting at any given moment will be far fewer than 1,000. A trackside station only communicates with a single on-train radio at any given time. Moreover, the system is not "always on" – a trackside station only transmits when a train is in position to form the other end of the link. Thus, each access point's transmission time is necessarily limited by the number of radio-equipped trains that Amtrak runs along the NEC at any given hour on any given day, and by the speed at which the train passes that access point. With an average train speed of 72 miles per hour along the NEC, any individual link will typically remain active for less than twenty seconds while a train is in motion, while trains resting in stations may be connected for several minutes.

It also must be emphasized that the fewer than 1,000 radios spread over the entire NEC in Amtrak's TSN is *de minimis* when compared with, for example, the thousands of outdoor Wi-Fi access points that are or will be deployed in the U-NII-1 and U-NII-3 bands across the entire country.[32] And, given scheduling of train service, even at peak traffic periods there are likely to be less than 50 trains in total actually operating along the entire 457 miles of NEC track at any one time, thus further mitigating the potential for harmful interference to Globalstar's satellites or other unlicensed users.

Amtrak's trackside stations will use a directional antenna with a narrow beamwidth consistent with the Commission's rules for fixed point-to-point systems. This allows the energy in each transmission to be maximized along the Amtrak right of way in order to provide connectivity to oncoming train-based radios going up and down the track. The TSN is designed to transmit only to

---

[32] *See 5 GHz R&O*, 29 FCC Rcd at 4139. The Commission believed that up to 200,000 units operating in the U-NII-3 band could potentially be modified to operate in the U-NII-1 band without causing harmful interference. In comparison, if 50 units were operating at any given time in the NEC, aggregate interference levels from the Amtrak network would be 39 dB below the levels that could be caused by 200,000 units.

trains operating within the right of way, and thus to minimize wasted energy that would occur if the RF signal were permitted to propagate outside of Amtrak's right of way.

The same lack of interference potential applies with equal force to Amtrak's operations in the U-NII-3 band. This spectrum is allocated on a primary basis to the Radiolocation Service for Federal operation, and on a secondary basis to the Amateur Radio Service for non-Federal operations.[33] Neither will be impacted by grant of the requested waiver, since the directionality of Amtrak's point to point transmissions, the relatively small number of Amtrak's trackside stations, and the intermittent and brief transmissions of those trackside stations will mitigate the possibility of harmful interference to incumbent operations. And, as in the case of the U-NII-1 band, Amtrak's operations pursuant to the waiver will create no greater interference potential than any of the fixed point-to-point operations already authorized in this band. In fact, a grant of the requested waiver for both the U-NII-1 and U-NII-3 bands will likely *reduce* the potential for interference by allowing Amtrak to use fewer trackside stations spaced further apart, thus minimizing an already extremely small risk of interference to incumbent users.

V. CONCLUSION

Permitting Amtrak to operate its point-to-point TSN using the FCC's technical rules for fixed point-to-point systems would have substantial, long term benefits without increasing any risk of interference to authorized users of the U-NII-1 and U-NII-3 bands. Moreover, the instant waiver request is limited to its facts and thus will not redefine "fixed" or otherwise create any precedent that would disrupt the RF environment in the unlicensed bands. It is also the only feasible alternative available to Amtrak at this time – additional spectrum is either unavailable or will not work. The requested waiver

[33] 47 C.F.R. § 2.106.

clearly satisfies the Commission's good cause criterion, and a grant thereof would serve the public interest.

Nonetheless, and consistent with OET's approach in *Deere & Company*, Amtrak is willing to have a waiver that is conditioned in a manner which ensures that other authorized users of the 5.1 GHz and 5.8 GHz bands should not suffer any harmful interference.[34] Imposition of these conditions will allow the Commission to tailor the grant of the waiver to the unique facts presented while permitting Amtrak to operate with the facilities necessary to deliver the public interest benefits discussed herein.

Therefore, for the reasons set forth above, Amtrak requests that the Commission waive Sections 15.407(a)(1)(iii) and 15.407(a)(3) of the Commission's rules to permit transmissions between Amtrak's trackside network and on-train radios to be treated as fixed point-to-point transmissions and thereby

[34] Amtrak has set forth in Exhibit A conditions that should assure that its operations under the waiver will not create harmful interference to other users of these bands.

eligible for operation under the technical rules for fixed point-to-point operations in the U-NII-1 and U-NII-3 bands.

Respectfully submitted,

NATIONAL RAILROAD PASSENGER CORPORATION d/b/a AMTRAK

/s/ *Vincent R. Brotski*

Vincent R. Brotski
Senior Associate General Counsel
60 Massachusetts Avenue, N.E.
Washington, DC 20002

Lawrence J. Movshin, Esq.
Robert D. Primosch, Esq.
Mark A. Settle, P.E.
Wilkinson Barker Knauer, LLP
1800 M Street, N.W.
Suite 800N
Washington, D.C. 20036
(202) 783-4141

December 13, 2016

EXHIBIT A

Proposed Conditions

1. The total number of stations, including both trackside and train-based stations, operating pursuant to this waiver must be fewer than 1,000.
2. Stations operating under this waiver are only permitted to operate within the Amtrak right of way along the Northeast Corridor.
3. Communication is only permitted from trackside stations to train-based stations – no direct consumer connection is permitted.
4. Amtrak must use equipment that is certified to meet the Commission's technical rules for point-to-point operation.
5. No data transmission is permitted from a trackside station unless a train is in position to receive the data transmission.
6. No more than 50 train-based radios are permitted to transmit simultaneously along the entire Northeast Corridor.